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L3: Entry 3 of 3 File: USPT Jul 4, 2000

DOCUMENT-IDENTIFIER: US 6084205 A
TITLE: Method for enhanced control of welding processes

Brief Summary Text (5):
Arc welding, and particularly gas tungsten arc (GTA) welding, is perhaps one of the most widely used manufacturing processes in the world. As a consequence, great efforts have been made to automate the process and, in particular, to use robotic welders in order to increase productivity and to improve the uniformity and quality of these welds. However, continued development of automated welding processes, particularly those carried out by general purpose manufacturing robots, require continuous information relevant to the quality of the weld being made. This information must, of necessity, be furnished on a real time basis, as the weld is being made, in order to be used as part of a feed-back mechanism to control critical parameters of the welding process.

Detailed Description Text (2):
The present invention provides a method and apparatus for controlling welding processes, in general, and for GTA welding, in particular, by measuring weld penetration and using the data derived therefrom, coupled with the use of dynamic feedback, to control welding process parameters. As will become evident to those skilled in the art from the following detailed description, the present invention is useful in many welding applications, such as e-beam welding and seam tracking, laser welding and seam tracking, and precision gas welding. However, for the purposes of illustration and convenience in introducing the present invention, application to GTA welding will be used as an example.

Detailed Description Text (5):
After passing through filter 120, light beam 115 enters video camera 125. Data from video camera 125 is fed to weld pool sizer W. Weld pool sizer W includes frame grabber 130 that captures a single video frame of the weld pool, such as that shown in FIG. 3, and uses a high speed analog-to-digital converter to digitize the analog video signal into discrete values representing the strength of the incoming video signal. A frame rate of at least 10 frames a second is required to handle controlling the weld process (control loop bandwidth is about 3 hz). The digitized data from frame grabber 130 is mapped onto a 100.times.100 pixel array. An imaging board 135, such as available from Spectrum Signal Processing, Burnaby, Quebec, Canada, performs a thresholding operation on the 100.times.100 pixel array to elevate all pixel intensities above a specific value to the maximum intensity and lowers all intensities below a specific level to the minimum intensity. The intensity level is set by manually adjusting the video camera iris so that the maximum weld pool intensity is approximately 98% of the maximum analog-to-digital scale such that no saturation occurs. The result of the thresholding operation is a two dimensional, black and white representation of the backside weld pool, FIG. 4(a), which is sent to signal processor 140 where the center of mass of the weld pool is calculated, FIG. 4(b). After determining the center of mass, signal processor 140 then determines the width and length of the backside weld pool, FIG. 4(c). It should be noted that the area of the weld pool can also be determined by a simple pixel count. These dimensions of the backside weld pool are then sent to controller 145 along with a desired value of the dimension(s) of the weld pool, the weld pool set point(s). The difference between the dimension (s) determined by signal processor 140 and the weld pool set point(s) is are used by controller 145 to control the welding current supplied by welder 150 to torch 155 by means of a dynamic feedback control algorithm.